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June 20, 2016

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Written *Ex Parte* Presentation

GN Docket No. 14-177, *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*

Dear Ms. Dortch:

In the above-referenced proceeding, the Commission has the opportunity to adopt rules that will allow almost all Americans to enjoy the benefits of Fifth Generation ("5G") wireless technologies in millimeter wave frequencies. To achieve that goal, the rules must permit providers to achieve wide-area coverage using today's wireless architecture—the approximately 300,000 cell sites currently deployed.[1/] Accordingly, the regulations must allow power levels consistent with wide-area coverage. Otherwise, millimeter wave 5G will be relegated to small cell applications, preventing the public from enjoying the full utility of 5G technologies or requiring providers to use significantly more cell sites to provide coverage, threatening the economic viability of the services.

In order to ensure providers can offer wide-area coverage, the Commission should raise the effective isotropic radiated power ("EIRP") limit for Upper Microwave Flexible Use Service ("UMFUS") base stations to 75 dBm per 100 MHz. 3GPP recently developed a technical report that studies the propagation characteristics of frequencies above 6 GHz.[2/] Using agreed-upon path loss models, the 3GPP report shows that 5G systems need to overcome a path loss of 167 dB in order to cover 95% of the users in Urban Micro deployment scenarios and 90% of the

[1/] *See* Clayton Funk, *et al.*, "Trends and Forecasts for the Wireless and Tower Industries," agl-mag.com (Sept. 2013), ***available at*** http://www.aaeconline.com/wp-content/uploads/2013/11/AGL-Trends-and-Forecasts-9-2013.pdf; *see also* Joey Jackson, "Report predicts tower, small cell outlook through 2025," RCR Wireless News (July 15, 2015), ***available at*** http://www.rcrwireless.com/20150715/cell-tower-news/report-predicts-tower-trends-through-2025-tag20.

[2/] *See* 3GPP TR 38.900 V1.0.0, "Channel model for frequency spectrum above 6 GHz," ***available at*** http://www.3gpp.org/ftp//Specs/archive/38_series/38.900/38900-100.zip.

users in Urban Macro deployment scenarios using bands around 30 GHz.[3/] Based on a 167 dB path loss, the link budget analysis we performed and attached below shows that 78 dBm EIRP in a 200 MHz channels will be needed in order to achieve 100 Mbps at cell edge.[4/] In other words, if the Commission allows UMFUS base stations to transmit at 75 dBm per 100 MHz, 5G services will be able to achieve 90% ~ 95% coverage with at least 100 Mbps data rate in urban deployments.[5/] This is significant as it implies that 5G will be able to achieve wide-area coverage with cell density consistent with 4G LTE networks. This will help ensure the economic viability of 5G in providing wide area gigabit mobility. This EIRP limit is still 10 dB less than the 85 dBm EIRP limit currently allowed for fixed services in the 28 GHz and 39 GHz bands. To help ensure the ability to provide 5G millimeter wave services on a wide-area basis—its highest and best use—the Commission should raise the EIRP limit for UMFUS base stations to 75 dBm per 100 MHz.

Many other parties agree that robust and economic deployment of innovative 5G technologies requires increasing the maximum allowable base station power levels from the proposed 62 dBm to 75 dBm per 100 MHz.[6/] Verizon, Samsung, Qualcomm, Nokia, Ericsson, and Intel have jointly stated that "the 62 dBm power limit would substantially and unnecessarily constrain 5G deployment."[7/] They acknowledged that while many parties have advocated for even higher power levels, "the consensus of this group is that 75 dBm is a reasonable compromise."[8/] AT&T, Ericsson, Nokia, Samsung, T-Mobile, and Verizon recently submitted a joint *ex parte* filing explaining that an increased EIRP of up to 75 dBm per 100 MHz "would not significantly increase the potential interference" to Fixed Satellite Service systems sharing the 28 GHz band.[9/] Accordingly, the record in this proceeding supports the adoption of technical rules that establish an increased base station power limit of 75 dBm per 100 MHz.

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Straight Path looks forward to working with all interested stakeholders to produce a timely resolution of this proceeding. Should there be any questions, the Commission is asked to contact

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3/ *See infra* Appendix I.

4/ *See infra* Appendix II.

5/ Similar link budget analysis cannot be performed for rural deployment at this time because 3GPP has yet to agree on a path loss model for millimeter wave frequencies in rural areas. Nevertheless, we expect a similar or better outcome for rural deployments because there is less clutter and generally lower building penetration loss in rural areas.

6/ Letter from Sanyogita Shamsunder, Verizon, *et al.*, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 14-177 (filed Apr. 21, 2016) ("Joint Proposal"); *see also* Letter from Dileep Srihari, Director, Legislative and Government Affairs, Telecommunications Industry Association to Marlene H. Dortch, Secretary, FCC, GN Docket No. 14-177, *et al.*, Attachment at 3 (filed June 15, 2016) (supporting Joint Proposal to increase base station power limits from 62 to 75 dBm per 100 MHz EIRP).

7/ *See* Joint Proposal.

8/ *Id.*

9/ *See* Letter from Stacey Black, Assistant Vice President – Federal Regulatory, AT&T Services Inc., *et al.*, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 14-177, at 6-8 (filed June 1, 2016).

the undersigned directly. Pursuant to Section 1.1206(b)(2) of the Commission’s rules, a copy of this letter has been submitted in the record of the above-referenced proceeding.

Respectfully submitted,

/s/ Davidi Jonas

Davidi Jonas
CEO and President
Straight Path Communications, Inc.

Attachments

Appendix I: Path Loss of 5G Systems in Urban Areas

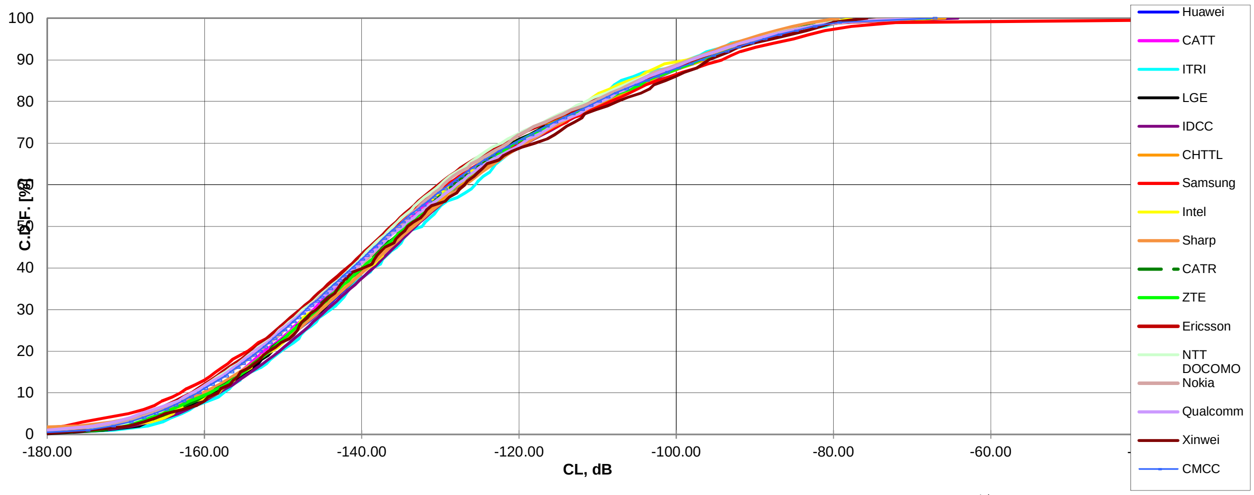

Figure 1. Path Loss of 5G system in Urban Micro deployment[1/]

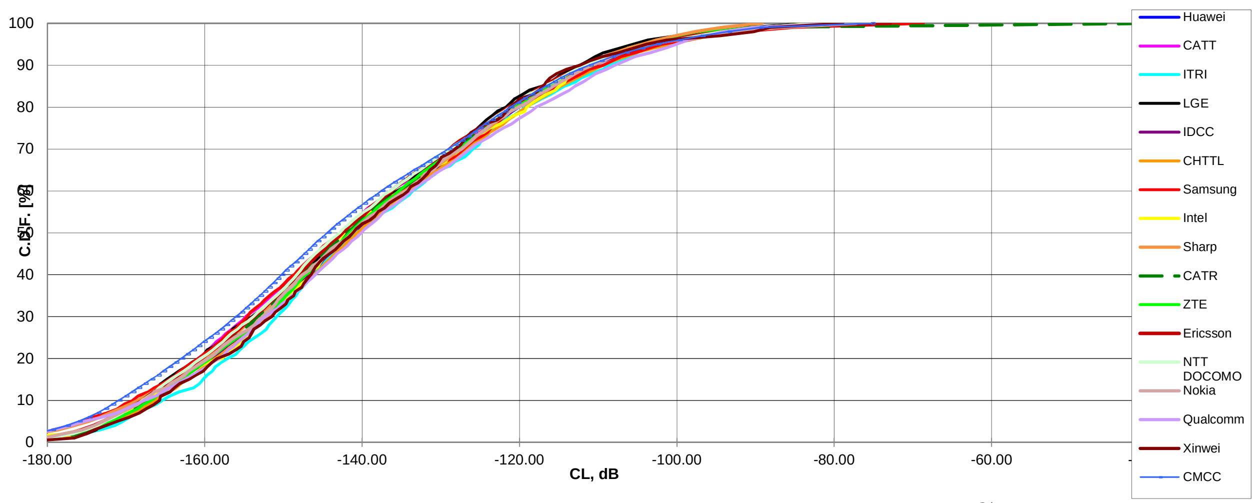

Figure 2. Path Loss of 5G system in Urban Macro deployment[2/]

In this calibration study, the user distribution is assumed to be 80% indoor and 20% outdoor. For the indoor users, 50% of the users are assumed to experience high-loss building penetration while the other 50% are assumed to experience low-loss building penetration. The results will be slightly different if these assumptions change. We believe these results are somewhat pessimistic because the percentage of indoor users that experience high-loss penetration should

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1/ *See* 3GPP R1-164802, "E-mail discussion summary of the large scale calibration," *available at* http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/R1-164802.zip.

2/ *See id.*

be much less than 50%.[3/] Nevertheless, these results are the most comprehensive to-date that provide a good benchmark of what is required to overcome path loss in the millimeter wave frequencies, and the EIRP level necessary in order for the system to be effectively deployed.

[3/] *See* 3GPP R1-165398, "Additional Considerations on Building Penetration Loss Modeling for 5G System Performance Evaluation," ***available at*** http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Docs/R1-165398.zip.

Appendix II: Link Budget Analysis for 5G Cell Edge Users

5G mobile service link budget	Downlink	Uplink	Uplink (CPE)
PA output power (dBm)	21	21	21
Number of PAs	256	8	16
Total output power (dBm)	**45**	**30**	**33**
Number of Tx antenna element	1024	8	64
Tx antenna element gain (dB)	6	6	6
Antenna & feed network loss (dB)	3	2	3
Total Tx antenna array gain (dB)	**33**	**13**	**21**
EIRP (dBm)	**78.00**	**43.06**	**54.10**
Path loss to achieve 90% ~ 95% coverage (dB)	**167.00**	**167.00**	**167.00**
Received power (dBm)	-89.00	-123.94	-112.90
Bandwidth (MHz)	200	200	200
Thermal noise (dBm)	-90.99	-90.99	-90.99
Noise Figure (dB)	7.00	5.00	5.00
SNR (dB) per Rx antenna element	-5.01	-37.95	-26.91
Number of Rx antenna element	8	1024	1024
Rx antenna element gain (dB)	6	6	6
Rx antenna feed network loss (dB)	2	3	3
Total Rx antenna array gain (dB)	**13**	**33**	**33**
SNR after beamforming (dB)	**8.02**	**-4.85**	**6.20**
Implementation loss (dB)	3.00	3.00	3.00
Number of MIMO streams	1	1	1
Spectral efficiency (bit/channel use)	2.06	0.22	1.63
System overhead	33%	33%	33%
Duty cycle	50.00%	50.00%	50.00%
Throughput (Mbps)	**138.19**	**14.70**	**108.96**